

A sulfide consuming reaction with large sulfur isotope fractionations in the long-term culturing experiment of sulfate reducing bacteria

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Microbial sulfate reduction is a key process in the biogeochemical C-S-Fe cycling: sulfate reducing microbes oxidize organic matter and reduce sulfate, which generates H₂S to react iron and precipitate iron sulfide. The activity of sulfate reducing microbes (SRMs) is preserved in iron sulfide, including pyrite, as evidenced by the sulfur isotopic composition. Previous studies showed clear inverse correlation between sulfur isotope fractionation (³⁴ε) of microbial sulfate reduction and cell specific sulfate reduction rate (csSRR) by the culturing experiments of SRMs. However, the 1.0 fmol/cell/day of csSRR achieved when the largest magnitude of the ³⁴ε value (-66‰) was observed in pure culture experiments is still much faster than the mean csSRR of marine sediments, below 0.1 fmol/cell/day. Here, we carried out a culturing experiment of a type sulfate reducer *Desulfovibrio desulfuricans* (DSM642) to quantify the ³⁴ε value in the stationary phase of cells, where the csSRR should be much lower than that of the exponential phase. We observed the magnitude of ³⁴ε value increased from -13.4 ± 3.6‰ in early exponential phase to -65.9 ± 21.0‰ in later exponential phase having clear negative correlation with cell specific sulfate reduction rate. However, ³⁴ε value in the stationary phase could not be quantified because of the decreasing H₂S concentration after stationary phase. A non-microbial H₂S-consuming reaction is interpreted to have occurred during the stationary phase and this had large sulfur isotope fractionations, -10.5 ± 1.1‰ and -45.6 ± 12.4‰. While the end-product of the H₂S-consuming reaction in the stationary phase remains unidentified, we found a reaction that generates a sulfur-bearing substance with a lower δ³⁴S value than that of H₂S. This reaction increases the δ³⁴S value of H₂S, which may account for the high δ³⁴S value observed in H₂S compared to pyrite and organic sulfur found in some modern marine sediments.